

Colorado Lagoon Restoration Alternative Components Analysis										
Components	Description	Infrastructure Changes	Environmental Benefits	Environmental Impacts	Habitat Changes	Hydrologic Regime	Flood Impacts	Maintenance Needs	Construction Costs	Maintenance Costs
Existing Conditions	No Changes	None beyond those existing	None beyond those existing	None beyond those existing	None	Tide range of: 4.5 feet; tidal residence time of: 1.6 days longer than Marine Stadium; tidal prism of: 64.4 ac ft; restricted tidal flushing	Maximum flood elevation at lagoon of: 5.7; requires erection of flood protection dike along Colorado St.	None	\$0	\$0
Improve Circulation and Tidal Connection										
1a	Clean Existing Culvert	Remove sills at each end; repair mechanical gates	Improved circulation and water quality, and reduced floodwater elevations	Removal of marine habitat colonized within culvert; temporary construction impacts of noise and exhaust impacts from equipment	Loss of fouling community in culvert, improved health and diversity of lagoon aquatic community	Tide range of: 5.9 feet; tidal residence time of: 1.0 day longer than Marine Stadium; tidal prism of: 82.6 ac ft; less restricted tidal flushing	Maximum flood elevation at lagoon of 5.2; dike still recommended along Colorado St.	Maintain and repair tide gates; remove debris and biofouling; clear trash rack	\$170,000	\$15,000
1b	Open Channel	Plug culvert; install new rip-rap channel and two bridges; re-route 6 major utility lines; safety fence along banks; move ballfield; remove trees	Significantly improved circulation and water quality, and reduced floodwater elevations	Less direct public access to recreational fields; temporary construction impacts of traffic from detouring and trucking, and noise and exhaust from equipment. Loss of fouling community in culvert, and possible impact to eel grass at Marine Stadium	Loss of fouling community in culvert, improved health and diversity of lagoon aquatic community	Tide range of: 7.7 feet; tidal residence time of: 0.8 days longer than Marine Stadium; tidal prism of: 103.8 ac ft; much less restricted tidal flushing	Maximum flood elevation at lagoon of: 4.3; requires no flood protection dike along Colorado St.	Repair revetment; maintain bridge, fence, signs; remove trash	\$3,500,000	\$20,000
1c	Open Channel Plus Existing Culvert	Same as open channel; assumes no cleaning of existing culvert (not necessary)	The greatest improvement to water circulation and water quality, and most reduced floodwater elevations	Same as above; less direct public access to recreational fields; temporary construction impacts of traffic from detouring and trucking, and of noise and exhaust from equipment; possible impact to eelgrass at Marine Stadium	Improved aquatic habitat in lagoon.	Tide range of: 7.9 feet; tidal residence time of: 0.5 days longer than Marine Stadium; tidal prism of: 105.8; least restricted tidal flushing	Maximum flood elevation at lagoon of: 3.8; requires no flood protection dike along Colorado St.	Maintain and repair tide gates; remove debris and biofouling; clear trash rack; repair revetment; maintain bridge, fence, signs; remove trash from channel	\$3,500,000	\$33,000
Evaluate the need to remove contaminated sediments										
2	Remove Sediment West Arm	Assumes the west lagoon lagoon arm is drained and dried - excavate 15,300 cy of sediment	Eliminates a significant environmental hazard and removes the lagoon from the 303d list; assumed to improve benthic conditions	Temporary construction impacts to: fish and benthic habitat and birds; of dewatering, noise, exhaust and traffic impacts from equipment and trucking; 3-year impact to impoverished benthic community from removing sediment.	Improved diversity of benthic and fish community in west arm.	No effect	No effect	None	\$630,000	\$0
3	Remove Sediment Central Lgn Area	Excavate 34,700 cy of sediment	Eliminates compromised sediment; may improve benthic conditions	More extensive temporary construction impacts to: fish and benthic habitat; of dewatering, noise, exhaust and traffic impacts from equipment and trucking; 3-year impact to larger benthic community from removing sediment; eelgrass removed. Possible temporary impacts to least tern foraging habitat.	No change	No effect	No effect	None	\$1,200,000	\$0
Identify pollutant sources and recommend controls in the watershed										
4	Watershed BMPs									
	i) Increased Enforcement on Construction Sites	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	\$10,000	\$10,000
	ii) Increase education/enforcement at commercial areas	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	\$75,000	\$75,000
	iii) Reduce lawn and golf course overwatering (education/enforcement)	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	\$200,000	\$200,000
	iv) Implement pesticide/herbicide management plan at golf course	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	Potentially 20% increase over current costs (could be offset by lower watering reqts)	Potentially 20% increase over current costs (could be offset by lower watering reqts)

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	v) Increase/improve City street sweeping	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	\$50,000	\$50,000
	vi) Enforce prohibition of no dry weather flow from home owners	None	Water quality improvement	None	Improved due to increased water quality	No effect	No effect	None	\$100,000	\$100,000
15	Trash mgmt	None	Reduces direct contribution of litter to the lagoon	None	Minor improvement to water quality and thus habitat	No effect	No effect	None	\$34,000	\$7,000
16	Bird mgmt	None	Reduces direct contribution of bird feces (bacteria) to the lagoon	None	Minor improvement to water quality and thus habitat	No effect	No effect	None	\$21,000	\$300
18	Watershed educational display	Interpretive displays	Provides public educational opportunity	None	No change.	No effect	No effect	Maintain displays	\$63,000	\$3,000
Restore and maintain estuarine habitat										
5a	Revegetate	Remove non-native vegetation; install native vegetation	Upland habitat improvement, trash screen along Colorado St. and Appian Way	Temporary construction impacts of noise, traffic, birds and exhaust from equipment and trucking	2 acres native upland/transitional	No effect	No effect	Remove weeds	\$320,000	\$8,000
5b	Recontour steep slopes (except by culvert) and Revegetate	Flatten side slopes at all steep sides except near culvert; Remove non-native vegetation; install native vegetation	Intertidal habitat expansion and improvement; upland habitat improvement, trash screen along Colorado St. and Appian Way	More extensive temporary construction impacts of noise, traffic, birds, invertebrates and exhaust from equipment and trucking; loss of grassy park areas	2 acres native upland/transitional; 6.5 acres wetland	No discernible effect; likely minor increase in tidal prism and increase in residence time	Minor indiscernible benefit of flood elevation reduction by incrementally increasing flood storage volume	Remove weeds	\$600,000	\$8,000
5c	Recontour all steep slopes and Revegetate	Flatten side slopes at all steep sides; Remove non-native vegetation; install native vegetation	Greatest intertidal habitat expansion and improvement, and upland habitat improvement; trash screen along Colorado St. and Appian Way	Most extensive temporary construction impacts of noise, traffic, birds, invertebrates, and exhaust from equipment and trucking	2 acres native upland/transitional; 7.1 acres wetland	No discernible effect; likely minor increase in tidal prism and increase in residence time, but greater effect than for 5b	Minor indiscernible benefit of flood elevation reduction by incrementally increasing flood storage volume; greater benefit than 5b	Remove weeds	\$660,000	\$9,000
6	West arm sandy habitat	Flatten low side slope along sandy beach west of beach to create more bird habitat area	Expansion and improvement to foraging shore bird habitat	Temporary construction impacts from dewatering, and of noise and exhaust from equipment; possibly traffic if soil trucked away	0.4 acres of mid marsh	No discernible effect; likely minor increase in tidal prism and increase in residence time	Minor indiscernible benefit of flood elevation reduction by incrementally increasing flood storage volume	None	\$110,000	\$0
7a	Swale and vegetated buffer along existing golf course fenceline.	Vegetated buffer along south golf course fence; vegetated swale along south side of buffer	Capture and filter drainage from golf course prior to reaching the lagoon; screen golf course from lagoon habitat areas	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, possible creation of mosquito breeding habitat if drainage were inadequate	0.4 acres of brackish marsh	No effect	No effect	Remove weeds and debris in swales	\$92,000	\$700
7b	Move fenceline back, swale and vegetated buffer along fenceline.	Move golf course fenceline back by ~20 feet; vegetated buffer along south golf course fence; vegetated swale along south side of buffer to capture and filter drainage prior to reaching lagoon	Expand upland and buffer habitat; capture and filter drainage from golf course prior to reaching the lagoon; screen golf course from lagoon habitat areas	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking; narrows fairways to 7th and 8th holes to constrain play,possible creation of mosquito breeding habitat if drainage were inadequate	0.4 acres of brackish marsh	No effect	No effect	Remove weeds; maintain fence	\$205,000	\$4,000
7c	Move fenceline back, swale and vegetated buffer along fenceline, berm on north beach.	Move fence and parking lot north; narrow parking lot & install permeable surface; vegetated buffer along south fence; vegetated swale south of buffer to capture and filter drainage prior to reaching lagoon; berm along north beach for sandy habitat protection	Further expansion of upland and buffer habitat (less disturbance to lagoon habitat); capture and filter drainage from golf course prior to reaching the lagoon; screen golf course from lagoon habitat areas; create protected shorebird habitat at north beach	More extensive temporary construction impacts of noise, traffic and exhaust from equipment and trucking, and reduced access; narrows fairways to 7th and 8th holes to constrain play,possible creation of mosquito breeding habitat if drainage were inadequate	0.4 acres of brackish marsh and 1.2 acres of coastal scrub	No effect	No effect	Remove weeds; maintain fence, permeable pavement, and berm	\$360,000	\$11,000

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7d	Move fenceline back, swale and vegetated buffer along fenceline, island on north beach.	Move fence and parking lot north; narrow parking lot & install permeable surface; vegetated buffer along south fence; vegetated swale south of buffer to capture and filter drainage prior to reaching lagoon; sand island off north beach as bird refuge	Further expansion of upland and buffer habitat (also less disturbance to lagoon habitat); capture and filter drainage from golf course prior to reaching the lagoon; screen golf course from lagoon habitat areas; create greatest protection to shorebird habitat at island	Most extensive temporary construction impacts of dewatering, noise, traffic and exhaust from equipment and trucking, and reduced access; narrows fairways to 7th and 8th holes to constrain play, possible creation of mosquito breeding habitat if drainage were inadequate	0.4 acres of brackish marsh, 1.2 acres of coastal scrub and 0.1 acre island	No discernible effect; likely minor increase in tidal prism and increase in residence time, but greater effect than for 7c	No effect	Remove weeds; maintain fence, permeable pavement, and island	\$620,000	\$13,000
8	More eelgrass	Install eelgrass throughout lagoon bed	Increase rare habitat for fish	None (hand placed with minimal impact)	Conversion of silt bottom to eelgrass bottom along edges of central portion of lagoon	No effect	No effect	None	\$62,000	\$0
Flood Control										
9	Flood berm	Install low earthen berm along Colorado St. @ Eliot to prevent flood overtopping	Protects surrounding areas south of the lagoon from flooding from lagoon overtopping during the 50-year return storm	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking	None	No effect	Maintains flood protection for areas outside of lagoon to the south for existing conditions; potential minor impact to upstream storm drains	None	\$34,000	\$4,000
Redirect or treat storm and low flows to minimize contamination of water and sediment.										
10	Sediment trap at west arm	Flood retention basin to capture sediment	Prevents potentially contaminated sediment from re-entering the lagoon during storm flows and depositing in the west arm	Most extensive temporary construction impacts of dewatering, excavation, noise, traffic and exhaust from equipment and trucking	None	No discernible effect; likely minor decrease in tidal prism and decrease in residence time	No effect	Periodic sediment removal	\$190,000	\$5,000
11	Storm drain outlet bio-swales	Demolish existing small local hard drain outlets; install earthen swales at outlets	Treats runoff from multiple small drains prior to reaching the lagoon	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, possible creation of mosquito breeding habitat if drainage were inadequate	Minor improvement to water quality and thus habitat	No effect	No effect	Remove weeds	\$100,000	\$200
12	Storm drains low flow diversion	New wet well storage basin, diversion structures at storm drain outlets, diversion lines to sewer trunk line	Diverts nuisance lows flows and first-flushes to the sanitary sewer system	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking	Minor improvement to water quality and thus habitat	No effect	No effect	Service diversion structure and remove debris	\$1,300,000	\$12,000
13	Eliminate 7th hole long tee	Close long tee; only use short tee	Precludes driving of golf balls over the western arm and ball litter problem	Shortens drive to 7th hole and reduces the quality of that golf experience	Improves benthic habitat	No effect	No effect	None	\$0	\$0
Enhance public enjoyment										
14a	Perimeter trail	Earthen trail along entire lagoon perimeter with interpretive boards	Provides improved pedestrian access and interpretive opportunities	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, and reduced access	No change	No effect	No effect	Maintain trails, kiosks, interpretive signs	\$230,000	\$8,000
14b	Viewing platforms	Raised structures and graded mounds for views	Provides improved vantage points and interpretation for the public	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, and reduced access	No change	No effect	No effect	Maintain trails, platforms/overlooks, interpretive signs, and telescopes	\$200,000	\$6,000
Create sediment management plan for imported beach fill sand										
17a	Existing sand nourishment	Import and place sand at beach	Maintains recreational beach in suitable condition as an existing practice	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, and reduced access	No change	No discernible effect; likely minor decrease in tidal prism and decrease in residence time	Minor indiscernible effect of reducing flood storage volume at lagoon	Deliver sand and regrade beach	\$16,000	\$8,000
17b	Modify sand nrshmt	Import and place sand at beach, but modified work	Maintains recreational beach in suitable condition, with less lagoon sedimentation in the center	Temporary construction impacts of noise, traffic and exhaust from equipment and trucking, and reduced access	No change	No discernible effect; likely minor decrease in tidal prism and decrease in residence time	Minor indiscernible effect of reducing flood storage volume at lagoon	Deliver sand and regrade beach, rake and groom smaller area	\$16,000	\$8,000
17c	Discontinue sand nrshmt	None	Reduced sedimentation in the lagoon	Poorer condition of the recreational beach and decreased quality of swimming/beach experience	No change	No effect	No effect	Rake and groom beach	\$0	\$3,000